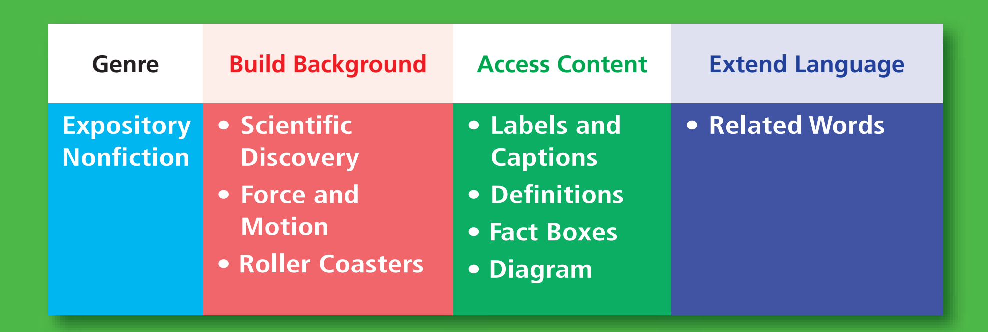


Science



Genre	Build Background	Access Content	Extend Language
Expository Nonfiction	• Scientific Discovery • Force and Motion • Roller Coasters	• Labels and Captions • Definitions • Fact Boxes • Diagram	• Related Words

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Science

Thank You, Sir Isaac Newton!



by Aaron Showley
Illustrated by Donna Catanese



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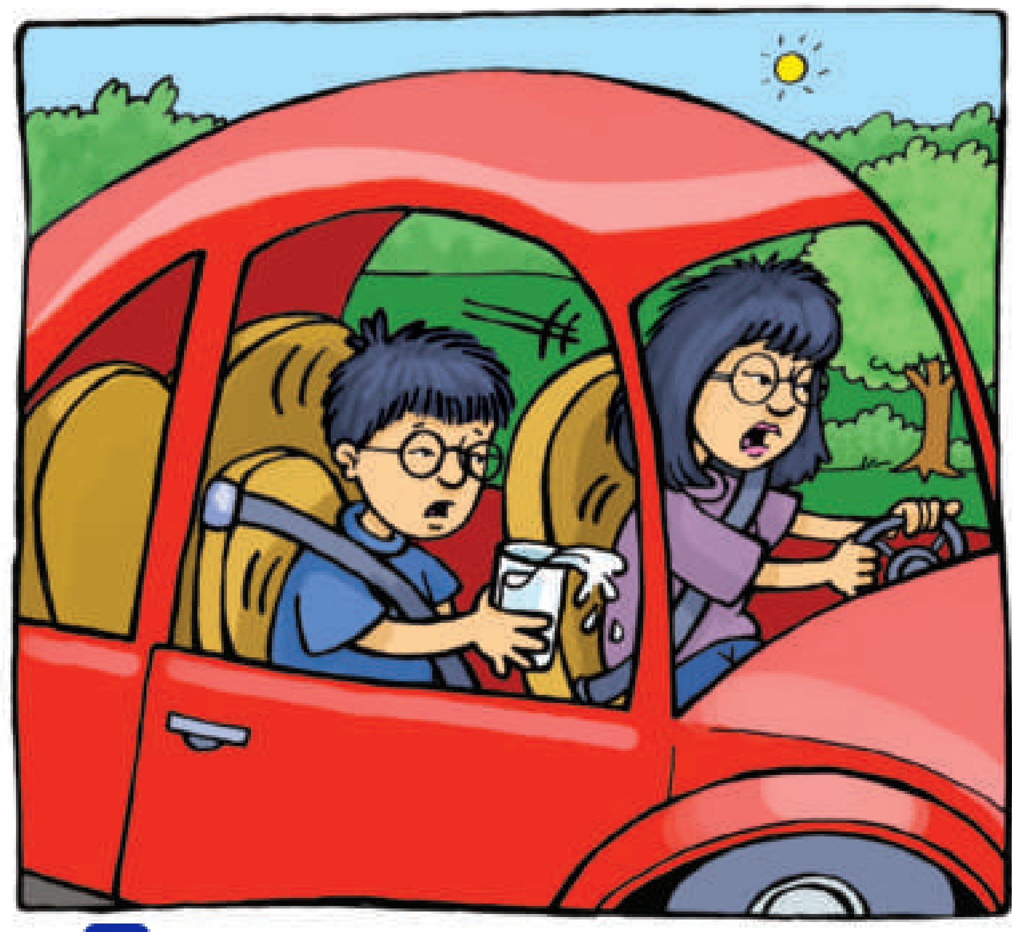
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Has this ever happened to you? You are in the car with your mom. You are drinking a cup of water. Everything is fine. But then another driver pulls right in front of your car. Your mom has to step on the brakes to avoid hitting the other car. Suddenly, your water is all over the floor, and you are wet! Your cup of water spilled. But you did not tip the cup, or drop it. What happened?

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brakes: devices that slow or stop something

avoid: prevent



Here's another problem. You are late for school. You are in a hurry. You put your books on the roof of the car, open the door, get in, and close the door. Mom starts the car and drives off. Yikes! You forgot to get your books off the roof of the car. The books fall down to the ground where the car was parked. Why?



Sir Isaac Newton

These things can be explained by a law of science called Newton's first law of motion. Sir Isaac Newton was a great scientist. He lived about 300 years ago in England. Sir Isaac Newton asked many questions about the world around him. He made observations about the world, and he did experiments. His work led him to discover the laws of motion.

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motion: movement

made observations: carefully looked at and thought



Did You Know? Laws of Science

- Laws of science are different from other laws. In everyday life, a law is a rule to follow. If you break a law, you get into trouble.
- A law of science is a law that everything in the universe follows. You can't break a law of science. Take the law of gravity, for example. If you drop a book, it falls to the floor. It doesn't fly up to the ceiling. Gravity pulls it down, toward Earth, toward the ground. That is a law of science.



In this book, you'll learn about Newton's first law of motion. Newton's first law says this: **Objects continue doing what they are doing unless another force acts on them.** An object at rest (not moving) stays at rest unless a force moves it. A moving object keeps moving unless a force stops it.

Newton's First Law of Motion

Object is at rest	Object is moving
↓	↓
Object stays at rest	Object keeps moving

break a law: disobey a rule

gravity: a force that pulls an object toward something else; a force that pulls things toward Earth

force: power or energy



But a moving object can stop moving, and an object at rest can be moved.



You can stop a moving object by pulling on it. For example, have you ever pulled a dog's leash? If you pull with enough strength to overcome a dog's movement, the dog will stop! When you push or pull, you are applying, or using, a force.

An object at rest will stay at rest until a force pushes it or pulls it. You can push it or pull it, and the object will move—unless it is too heavy! A thing may move if you kick it. But do not kick something that is too heavy. Your foot might suddenly stop!





Let's look at what happened to the water in the car. The water in your cup was moving. It did not look like it was moving because it was moving along with the car. If the car was traveling forward at 30 miles per hour, the water was traveling forward at 30 miles per hour too.

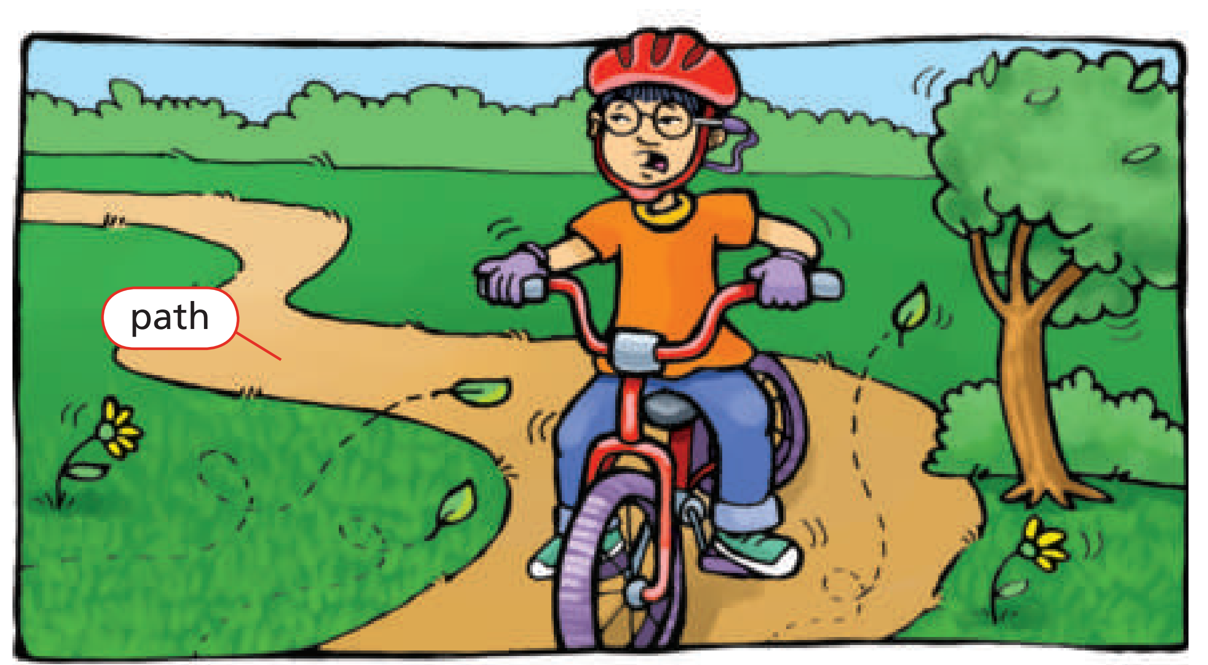
When your mom stepped on the brake pedal, the car slowed down or stopped. The car's brakes made the car stop. Your water did not have brakes, so it kept going—right onto the floor. Remember, a moving object keeps moving until a force stops it. That is the law!

Why did the brakes stop the car? Brakes work because of friction between parts of the brakes and the wheels, and between the tires and the road. The friction was stronger than the car's movement forward, so the car stopped. But there was no friction to stop the water so quickly, so it kept moving.

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friction: the rubbing of one object against another





Let's take another look at Newton's first law. You are riding a bicycle on a flat road. It is easy to ride the bike. You turn a corner, and the wind is in your face. Suddenly, it is harder to pedal. What happened? You are still pedaling just as hard, but the force of the wind is pushing against you. The wind is strong, so your bike slows down.



Did You Know? **Friction**

- Bike riders understand friction. It is harder to go fast on a rough path than on a smooth one because a rough path causes more friction. Friction slows movement.
- A bike's brakes work because of friction too. When you press your brakes, parts of the brakes press against a moving wheel. The bike slows down or stops.





The Giant Dipper in Santa Cruz, California, was built in 1924, but people still love it today.



We have discussed Newton's first law of motion. Sir Isaac Newton was a thinker and a dreamer. Many other people are dreamers too. People love to use their imaginations. A scientist makes a discovery, and then people think, "How can we use this discovery? What new thing can we make?"

People have used Sir Isaac Newton's ideas to make their dreams come true. One man who did that was LaMarcus Thompson.

In the 1880s, LaMarcus Thompson used his knowledge of Newton's laws of motion to build a roller coaster! Thompson's ride was built in 1884 at Coney Island, New York. The age of roller coasters had begun! People ride in a train of small cars that roll, or move, up and down on a roller coaster's tracks—just for fun.



Here is how an old-fashioned, wooden roller coaster works.

A motor and chain start the train by pulling it to the top of a tall hill. After that, the train is on its own. There is no engine in the train. There is no electricity running through the tracks.

Earth's gravity pulls the train down the hill. The train is heavy, so it goes fast. For example, riders on the Giant Dipper drop from a height of 70 feet. The train goes 55 miles per hour down the hill.

As the train speeds down the hill, Newton's first law of motion takes over. Remember: **A moving object keeps moving unless another force acts on it.** The train is moving, so it keeps on moving. The train uses its momentum to go up, down, and around the track.



is on its own: has nothing to help it





During most of the ride, friction and wind are not strong enough to slow the train. A heavy, fast-moving train has much momentum. But near the end of the ride, the train has to slow and stop.

Inventors of roller coasters use the laws of motion to slow and stop the trains too. Some roller coasters have a long, straight, flat track near the end of the ride. On this flat track, the train loses some momentum. Then, the train goes up a small hill. Gravity pulls on the train as the train goes up. This slows the train too. Next, bumpers on the track create friction. Finally, the wheels push up against a barrier. The train stops.



Did You Know? **Momentum**

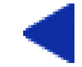
A moving object moves with force, or momentum.

The amount of momentum depends on two things:

- how fast the object is moving
- how heavy the object is



barrier: thing that blocks the way or stops movement







In some steel roller coasters, riders sit on seats hanging from a rail above them. Their legs hang free as they would in a glider.



Today's roller coasters are smoother and faster than early roller coasters. Many of them glide along on smooth, steel tracks. The new, smooth tracks reduce friction, or drag, on the train so the train can go very fast! La Marcus Thompson's tracks were built out of wood, but both kinds of roller coasters use force, momentum, and friction to work.

steel: strong metal


Sir Isaac Newton



The laws of motion have always worked. Sir Isaac Newton did not invent them. But he did explain how they work.

Thanks to Sir Isaac Newton, we understand the laws of motion. You use them when you ride your bike or kick a ball. Inventors use them to dream up new inventions, including new rides for amusement parks! Maybe you will invent a ride one day. What kind of ride would you like



Talk About It

1. Look at the diagram on page 4. Explain Newton's first law of motion in your own words.
2. Give an example of a force that can stop a moving object.

Write About It

3. On a separate paper, write a definition, draw a picture, or give an example of the following key words from the book.

Word	Definition, Illustration, or Example
motion	
gravity	
force	
friction	
momentum	

Extend Language

The word *motion* means "movement." The words or phrases *motionless*, *locomotion*, and *motion picture* are related to the word *motion*. Use a dictionary to find out what each word or phrase means.

Photographs
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